

# ENERGY INFORMATION PAPER

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## Planning the Electricity Supply System



Ministry  
of  
Energy

Honourable  
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Minister



# Planning the Electricity Supply System

## INTRODUCTION

Ontario's electric power system is expected to supply the electricity needed by the province at the lowest feasible cost and in a safe and reliable manner.

Demand for electricity is growing as a result of economic growth, multiplying applications for the unique properties of electricity, and initiatives designed to reduce our dependence on imported oil. The electrical power system therefore must grow as well.

The provincial government's policy on electricity in Ontario is highlighted by the Board of Industrial Leadership and Development (BILD), which has stated that: The province's electrical system will be utilized whenever practical to substitute for oil consumption, thereby complementing national and global off-oil initiatives. This strategy will obtain massive economic benefits from substituting an indigenous energy source for petroleum, will provide greater energy security for Ontario's economic future and will keep Ontario in the forefront of electric power technology.

The government's commitment to electricity in Ontario was re-emphasized in the Speech from the Throne in March 1984.

The various demands on the province's electrical system have to be met within Ontario Hydro's mandate and financial capability. The construction of generating capacity and transmission facilities requires long lead times and the investment of large amounts of capital. Projects must also meet environmental restrictions and safety concerns in a climate of rapid technological change and economic uncertainty.

Electric Power System Planning is the complex process which provides the context for meeting the many conditions and requirements placed on the electrical system.

There are many participants in the electric power planning process. These include Ontario Hydro, the Ministry of Energy as well as other Ministries of the provincial government, the Ontario Energy Board, special interest groups, and of course the people of Ontario, most of whom are electricity consumers.

## THE PLANNING PROCESS

Ontario Hydro is responsible for planning the power system so that electricity supply can meet the demand at any given time and in a variety of situations. The Corporation's generation and transmission plans are based on forecasts of long-term load, economic outlook, and other trends which will affect future requirements for electricity. In addition to generation and transmission plans, Ontario Hydro applies a variety of management tools to help match patterns of supply and demand, such as increased production, marketing, conservation, and load management. All of these electrical energy management techniques are part of Ontario Hydro's strategic plan.

A variety of mechanisms ensure that Ontario Hydro's power system planning activities are consistent with provincial government policy and the needs of the province.

## THE POWER CORPORATION ACT

The Power Corporation Act authorizes Ontario Hydro to generate, supply, and deliver electric power throughout the province. The Minister of Energy is responsible for administering the Act and for giving broad policy direction to Ontario Hydro.

Examples of such policy direction, which provide the context for electric power system planning, are the government's strategies for the wise and wider use of electricity outlined in the Ministry of Energy's report entitled "Energy Security for the 80's," and by the BILD program.

## THE MEMORANDUM OF UNDERSTANDING

In 1982 Ontario Hydro and the Ontario government, represented by the Minister of Energy, completed and signed a Memorandum of Under-

standing. This memorandum clarifies the objectives and priorities of the Corporation, sets out the operating relationship between Ontario Hydro and the Ministry of Energy, and outlines the responsibilities of each party to the other.

In compliance with the Memorandum of Understanding, Ontario Hydro is required to submit annually its strategic planning documentation to the Minister of Energy for review. These documents include:

- The corporate strategy
- The load forecast
- The generation development plan
- The transmission development plan
- The capital construction program
- The financial forecast

The Minister of Energy also keeps Hydro informed about government energy-related policy. This process is designed to ensure that Ontario Hydro carries out its responsibilities in harmony with government policy.

## APPROVAL OF MAJOR FACILITIES

The approval of Cabinet, expressed in an Order-in-Council, is required whenever Ontario Hydro wishes to build a generating station or a transmission line. Orders-in-Council are approved only after a full review of the necessity for additional facilities, the alternatives and cost of the proposed action, and the future impact of the system expansion plan on the economy and the environment. This review by Cabinet is an important step in the electric power planning process.

The Ontario Hydro Board is responsible for the ongoing review of the Corporation's projects in light of continually changing financial and economic conditions. An option available to the Board to meet these conditions is the adjustment of construction schedules. These ongoing reviews are carried out in consultation with the Ministry of Energy and other provincial government ministries and agencies with a policy interest in Ontario Hydro's affairs.

A recently completed review confirmed that continuing with the Darlington project as scheduled would be in the best interest of Ontario.

## ENVIRONMENTAL APPROVALS

Major Ontario Hydro electric power projects, such as generating stations and bulk transmission lines, must meet the requirements of provincial environmental statutes. The Environmental Assessment Act, 1975 requires the submission of documentation for government review and approval. This documentation must describe the "undertaking", the alternatives to the undertaking, the predicted effects, and the overall costs and benefits of implementing the undertaking or one of its alternatives. The statute also provides the Minister of the Environment with the authority to require a public hearing on the undertaking before the Environmental Assessment Board.

In addition to complying with the Environmental Assessment Act, major Ontario Hydro projects may also require approvals under a variety of other statutes such as the Expropriations Act or the Ontario Municipal Board Act. In the past the potential of a multiplicity of hearings before a variety of boards and hearing officers often resulted in delays and unnecessary duplication.

To avoid such situations the Consolidated Hearings Act, 1981 was enacted. This statute provides the authority for the establishment of a joint hearing board composed of members of both the Environmental Assessment Board and the Ontario Municipal Board. A joint hearing may be convened for major electric power projects for which more than one hearing would otherwise be required.

## PUBLIC HEARING



Public participation is an important factor in Ontario's electricity supply system planning process.

The joint board has the authority to combine all such hearings and to make all decisions respecting approvals and permits required by all consolidated statutes.

## REVIEW OF ONTARIO HYDRO'S BULK ELECTRICITY RATES

The costs of electric power planning decisions must be recovered through the rates. It is in the interest of all consumers to keep system expansion costs as low as possible whether the additional electricity is to be used in the home or in the factory.

The Ontario Energy Board Act requires the Minister of Energy to submit Ontario Hydro's proposals to change its bulk power rates to the Ontario Energy Board (OEB) for investigation, examination, and report. In its review the OEB considers the impact of the system expansion program on the proposed rates. A public hearing is an integral part of the review process and allows interested electricity consumers, or their representatives, an opportunity to actively participate in the decision-making process.

## SPECIAL REVIEWS OF ELECTRIC POWER PLANS

Although the electric power planning process described above normally allows a sufficient review of Ontario Hydro's plans, there are occasions when the provincial government considers that a broader public review might better serve the public interest. The Ontario Energy Board, a Royal Commission, and a Select Committee of the Legislature have provided appropriate forums for these special reviews.

## THE ONTARIO ENERGY BOARD

In 1973 Ontario Hydro developed a generation development plan for the period 1977 to 1982. In view of the extent of the plan the Minister of Energy referred the plan to the Ontario Energy Board (OEB) and requested that it review the plan and report to him on the "policies and practices respecting expansion of the Ontario Hydro Power System, including the Generation Development Plan." Public hearings, beginning in January 1974, reviewed the need for the proposed generation in light of the

### ONTARIO ENERGY BOARD



Public hearings are held to review bulk power rates and other policies and programs referred by the government.

then current load forecast. The need for heavy water plants for the nuclear program was also reviewed. On the basis of the OEB report, the government agreed to the construction of new generating stations subject to individual Order-in-Council approval. Stations approved at that time, including Pickering B, Bruce B, and Atikokan, are now coming into operation.

## THE ROYAL COMMISSION ON ELECTRIC POWER PLANNING

The Royal Commission on Electric Power Planning (RCEPP) was also established by the provincial government to review the necessity of the very ambitious electric power expansion program announced by Ontario Hydro in 1973 and the planning principles underlying the expansion program.

The Government accepted 77 of the Commission's 88 recommendations, and these were translated into real improvements in electric power system planning in Ontario. In fact, by the time the Commission formally published its report in March 1980 Ontario Hydro had already implemented many of the recommendations.

## THE SELECT COMMITTEE OF THE LEGISLATURE

In 1977 the Ontario Legislature set up an all-party Committee of the Legislature on Hydro affairs. This Committee held public meetings to review and report on "The Need for Electrical Capacity." The report of the Select Committee was completed in December 1979 and included a review of Ontario Hydro's Generation Expansion plan, the requirement for Heavy Water plants, and Ontario's nuclear commitment.

The report of the Select Committee was tabled and debated in the Legislature in 1980.

## FACTORS INFLUENCING ELECTRIC POWER SYSTEM PLANNING

Electric power system planning is influenced by a number of factors, of which the most important are supply, demand, financial, economic, social, and environmental concerns.

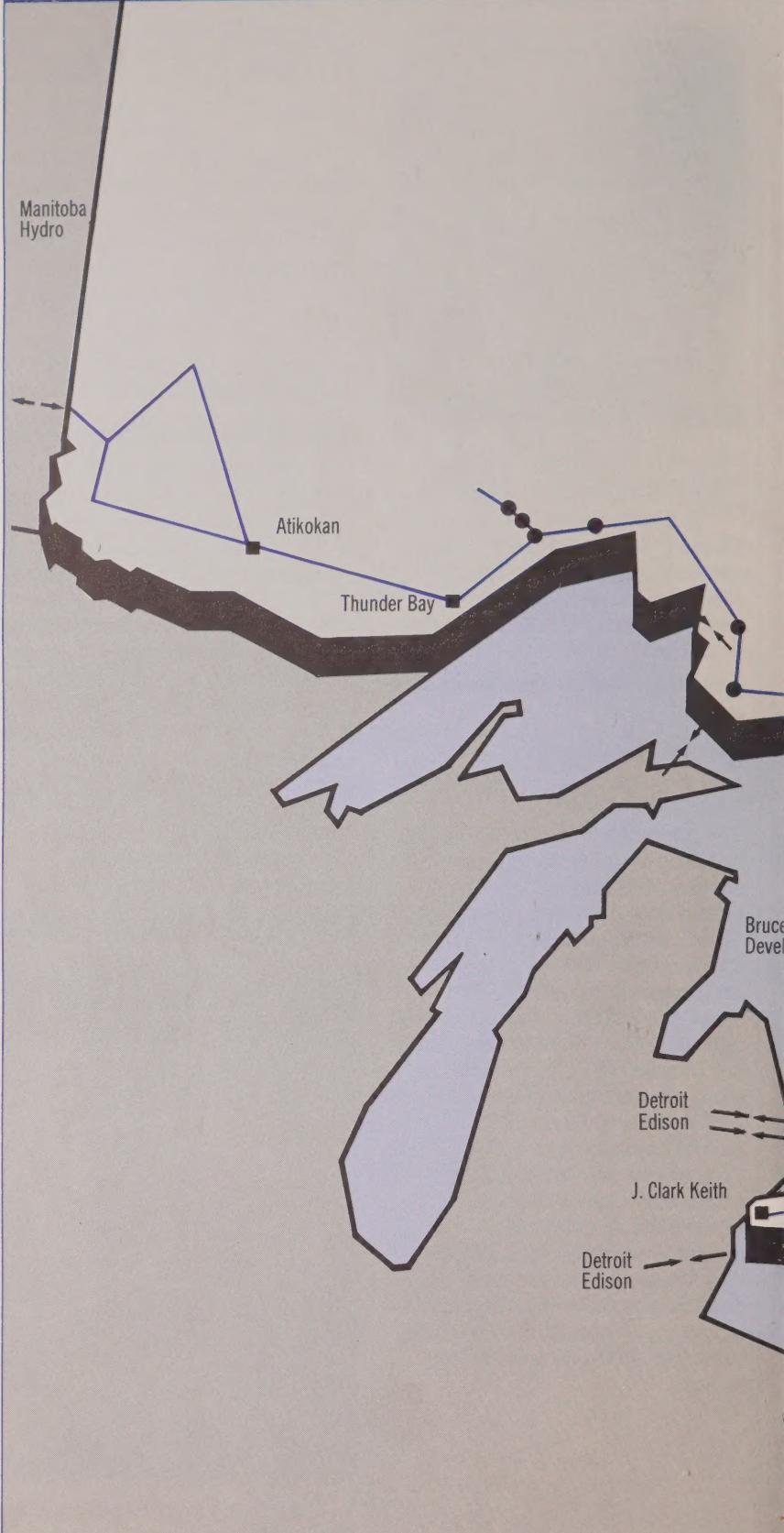
## ELECTRICITY SUPPLY

Ontario's Electrical Power System is made up of Ontario Hydro's bulk power generation and transmission system and its rural distribution system, along with the municipal electric distribution systems, and a number of smaller electric supply systems serving remote communities not connected to Ontario Hydro's grid. The electric power supply industry also includes a number of private electricity generators and distributors.

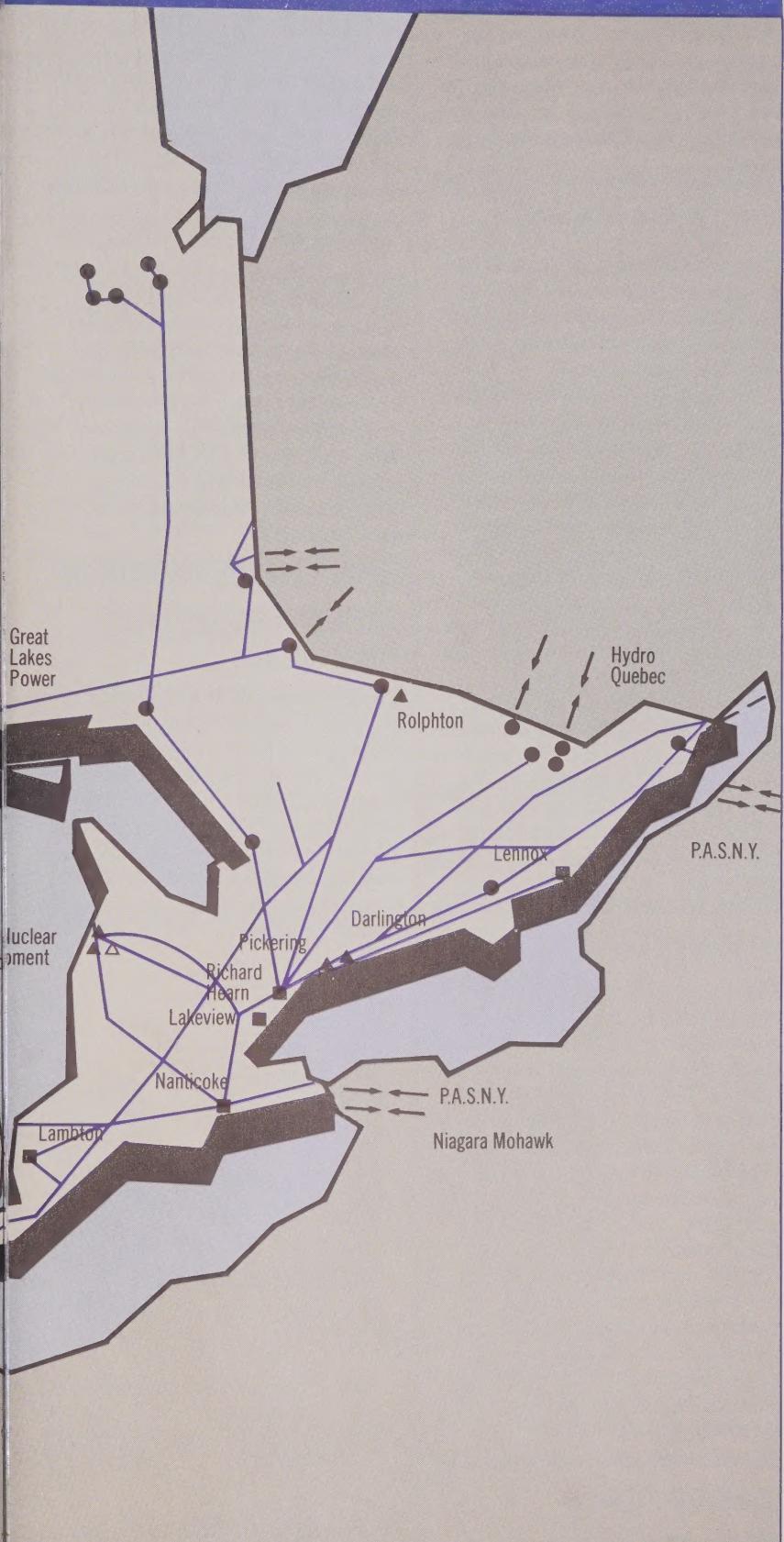
Ontario Hydro is one of the largest electric utilities in North America, and its bulk electric system supplies about 95 per cent of the total electric power demand in Ontario.

Electricity may be supplied directly to the consumer by Ontario Hydro, as in the case of 103 direct industrial customers and approximately 760,000 rural customers, or it may be supplied by one of the 315 municipal utilities which purchase their power from Ontario Hydro.

## ONTARIO'S ELECTRICITY SUPPLY SYSTEM



Ontario's electrical system is also interconnected with neighbouring utility electric systems in Quebec, Manitoba, New York, and Michigan. These interconnections make group assistance available instantaneously to a member system suffering the loss of generating capacity or load. They also provide access to larger markets for the export of surplus electricity.



## ONTARIO HYDRO SYSTEM

Ontario Hydro generates virtually all of the electricity produced in Ontario.

Its stations and transmission lines extend throughout the province.

Power Authority of State of New York (P.A.S.N.Y.)

Generating stations in or under construction operation in 1985

500 kV and 230 kV transmission lines

- Hydraulic
- Fossil fuelled
- ▲ Nuclear
- △ Heavy water plants
- Routes of main power flow
- ◀ Interconnections with other systems

## THE GENERATION SYSTEM

By the time Ontario Hydro's currently committed generation program is completed in 1992, it will have a total generating capacity of about 33,900 megawatts installed capacity. This will be made up of 68 hydro-electric plants with a dependable winter peak capacity of 6,500 megawatts; 14,050 megawatts of nuclear capacity at five nuclear stations each with four reactors; 13,350 megawatts of fossil-fired capacity at eight major fossil-fired stations, and a number of smaller combustion turbine units scattered around the province.

Three of the province's five privately owned electric utilities generate over 350 megawatts of electricity, and a number of large industrial companies generate about 900 megawatts primarily for their own use. In addition, some electricity is produced by alternative forms of generation such as wind, photovoltaic, and energy from waste.

## THE TRANSMISSION SYSTEM

Ontario's existing transmission system is based on a solid foundation of 115 and 230 kilovolt electrical transmission lines which constitute about 80 per cent of the bulk transmission circuit miles. Since the 1970s, the size of Ontario's electrical system and the efficiency and economies of scale of Ontario Hydro's generation program and the choice of their location have dictated the creation of a firm backbone of 500 kilovolt transmission to link the major generation centres with the major load centres.

As the electrical system in Ontario grows, in response to increased demand and the need to ensure that the failure of critical circuits will not lead to widespread outages, Ontario Hydro will be required to strengthen its 500 kilovolt transmission system. Two major efforts in this regard, planned for the late 1980s and 1990s, are the Southwestern Ontario and Eastern Ontario Bulk Transmission Expansion Programs.

The implementation of these programs is required to ensure that new

generating capacity being installed at the Bruce Nuclear Power Development and at Darlington can be fully used and that the supply of power to major load centres such as London and Ottawa is sufficient to meet demand.

## ELECTRICITY DEMAND

Prior to 1973 electricity demand had grown at a steady rate of 7 per cent per annum, and Ontario Hydro had planned its system expansion forecasts based on this trend.

In the early 1970s a number of factors, including the first world oil crisis with its devastating effect on economic growth, resulted in reductions in demand forecasts. Changes in the forecast demand can have a significant effect on the electrical system requirements. Ontario Hydro's 1985 forecast shows an increase of 2.6 per cent per annum of peak winter demand for electricity for the period 1981 to 2000.

Each year the Ministry of Energy also develops long-range forecasts for energy, including electricity, which it discusses with Ontario Hydro. Ontario Hydro takes the Ministry's energy forecasts into consideration in finalizing its own forecast of electricity demand.

## LOAD MANAGEMENT

The pattern of electricity demand may be influenced by load management, which is the process of shifting energy use from one time period to another. This will help displace the need to burn coal by shifting demand from periods when coal would have to be burned to generate electricity to periods when surplus nuclear power is available. In the long term, load management will also reduce the need for additional capacity to meet an increase in peak demand. Load management experiments currently underway in Scarborough and Oshawa, if successful, may result in a program for 1,400 megawatts of managed load by the year 2000.

## CONSERVATION

The demand for electricity can also

be influenced by a variety of conservation measures. The Ontario government, Ontario Hydro, and the municipal electric utilities have established a number of conservation programs which encourage the wise and efficient use of electricity.

## ENVIRONMENTAL CONCERN

Ontario Hydro's electric power system planning activities must take into consideration a variety of environmental concerns including land use, water quality, and acid rain. The Corporation must comply with the requirements of the Environmental Protection Act 1971, the Environmental Assessment Act, 1975, and any other statute relevant to a particular development.

## EMERGING ISSUES FOR THE 1990's

The electric power planning process provides the opportunity to consider a variety of concerns about the impact of electrical system expansion. Issues likely to emerge in the 1990s include the need for additional transmission and generation facilities, the most appropriate form of generation, environmental concerns, and the export of electricity.

## THE NEED FOR ADDITIONAL FACILITIES

The key factors influencing the need for additional facilities are the demand for electric power, the security and reliability of supply, the optimal generation mix, and social environmental concerns about transmission facilities.

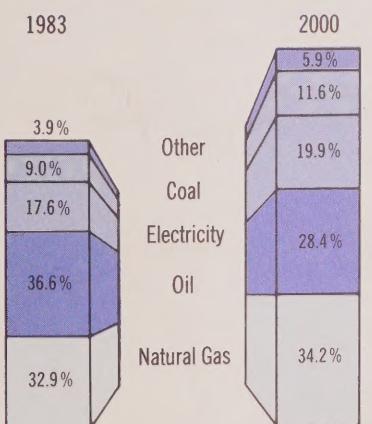
### DEMAND

In 1983 electricity constituted 17 per cent of the energy used in Ontario. The balance of the energy demand was served by other sources: oil 37 per cent, natural gas 33 per cent, coal 9 per cent, and other sources 4 per cent. Electricity's share of the energy market is expected to grow.

Electricity is a clean, convenient, and an efficient form of energy at the point of utilization. Reliable electricity supply is essential for a wide range of applications. However, electrical generation, transmission, and distribution facilities require a substantial capital investment and have a very significant impact on Ontario's economy and the environment.

Therefore the wise use of electricity has particular significance in the development of Ontario's energy policy.

### SECONDARY ENERGY USE IN ONTARIO

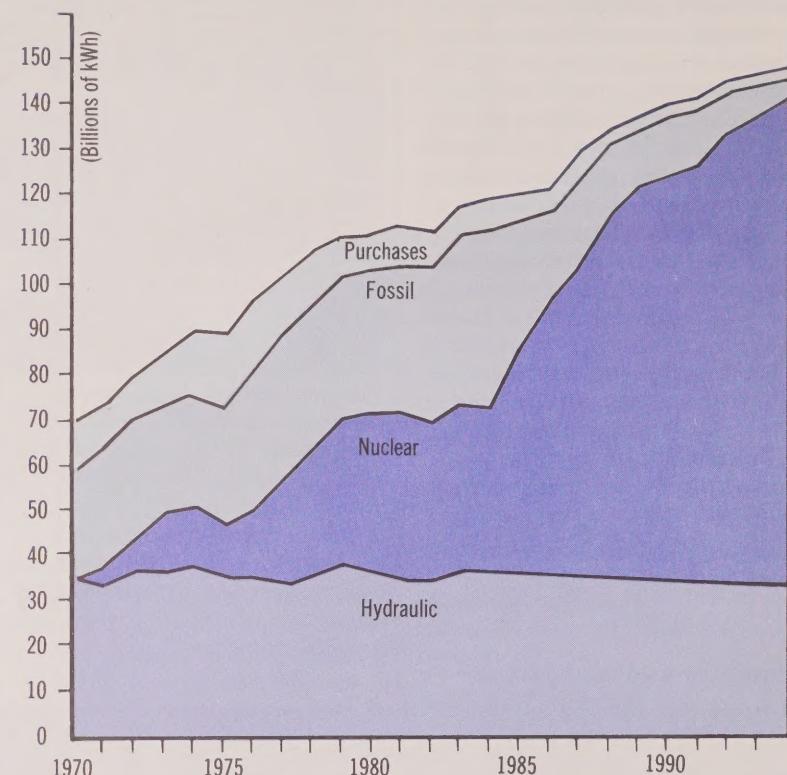


571.7 billion kWh equivalent  
336.3 million barrels of oil equivalent

741.9 billion kWh equivalent  
435.4 million barrels of oil equivalent

Electricity's share of Ontario's energy market is expected to grow.

ELECTRICITY SUPPLY IN ONTARIO (1970-1993)



A growing reliance on nuclear generation will increase energy security through the development of an indigenous resource.

### RELIABILITY AND ENERGY SUPPLY SECURITY

Electricity consumers, particularly those commercial and industrial customers who work in an extremely competitive marketplace, depend on an economic and reliable supply of electricity.

What constitutes an adequate level of electric supply reliability must be decided in the context of the financial feasibility and the environmental and social costs and benefits of providing various levels of supply.

The reliability of the electric power service depends on the security of the electrical power system. This security of supply depends on the extent of the transmission and distribution networks, the dependability and type of generation, the generation reserve margin, and the interconnection capacity with neighbouring jurisdictions.

### GENERATION MIX

By 1993 nuclear generation will provide 70 per cent of the total electrical energy production in Ontario.

Hydro-electric generation will provide about 24 per cent, and coal-fired generation 6 per cent.

This mix in favour of nuclear generation will minimize the long-term cost of electricity. However, decisions about the development of additional generation will need to weigh carefully the costs and benefits of maintaining current electric supply system flexibility as against choosing a system that will increase the degree of dependence on any particular generation technology. Some of the options that will be considered are demand management, rehabilitation of existing fossil-fired stations, firm purchases or joint developments with neighbouring utilities, development of new fossil, hydraulic, or additional nuclear units, as well as new small-scale electrical generation technologies.

## TRANSMISSION

As Ontario's electrical system grows in response to demand, transmission considerations for the future will become increasingly significant in decisions concerning future investments in supply and demand technologies. Major legislative innovations have been implemented by the Government of Ontario to accommodate the social and environmental concerns that arise with decisions regarding the choice and location of new transmission facilities. Future decisions to locate new developments on agricultural or recreational land will pose a continuing challenge for both Ontario Hydro and the public institutions responsible for the review and approval of proposals.

## OPTIONS FOR ELECTRICAL GENERATION

There are a number of options for

the future generation of electricity. These include hydraulic, nuclear, coal, and alternative methods of generation.

## HYDRAULIC GENERATION

Ontario's electric system was originally based on hydro-electric power. By the 1950s, however, the province's most accessible and economic water power resources had been developed. As the demand for electricity grows the contribution of hydro-electric generation will fall from 30 per cent at present to 24 per cent by the mid-1990's.

There are still hydro-electric resources which could be developed, and Ontario Hydro is studying sites with a potential peak capacity of 3000 megawatts in total. Although most of the potential sites are relatively small, and would be of value mainly as peaking plants, their development would provide economic and supply security benefits.

In addition, there are a number of smaller sites each with a potential of less than 10 megawatts. The Ministry of Energy's Small Hydro Development Program is helping to identify and encourage the development of these sites, but they will not make a major contribution to the Ontario power system, because the best estimates indicate that there are potentially only 500 megawatts of small hydro in Ontario.

The Ministry of Energy has set a target for 100 megawatts of new small hydro by 1995.

New hydroelectric generation could be valuable in meeting peak loads. However, major new base load generation will have to be met by coal or nuclear generation.

**HYDRO-ELECTRIC GENERATING STATION WITH PUMPED STORAGE**



Hydro-electric generation was the backbone of Ontario's electrical system.

## COAL-FIRED GENERATION

Fuel for the coal-fired stations is brought into Ontario mainly from the United States. Over the past twelve years its cost has increased by 600 per cent, and in the longer term further cost increases are likely. Coal burned at generation stations also requires costly design measures to avoid environmental hazards such as acid gas emissions.

## NUCLEAR GENERATION

Nuclear power uses an indigenous fuel source which is in plentiful supply, and since it displaces coal-fired generation it reduces acid gas and other toxic emissions. Nuclear plants have higher capital costs but lower fuel costs than coal-fired stations.

## ALTERNATIVE GENERATION

Alternative generation is electrical generation in Ontario by someone other than Ontario Hydro and non-conventional generation by Ontario Hydro. The established types of alternative generation are private hydro-electric and cogeneration. Together these provide 1200 megawatts of generation in Ontario. Exciting future possibilities exist for photovoltaics, energy from waste, wind power and biomass. Both Ontario Hydro and the government of Ontario encourage the development of these technologies.

## "SOLAR" RANGER STATION



Quetico Park, Ontario

Photovoltaic and other alternative generation technologies may often be the most suitable means of supplying electricity in remote locations.

The contribution these technologies will make to the electrical system will be limited through the 1990s because the power produced is often more expensive than power produced by conventional means.

## ENVIRONMENTAL CONCERN

### ACID GAS

Ontario Hydro's acid gas emissions are currently regulated with emission levels set at 450 kilotonnes by 1986 and 300 kilotonnes by 1990. In early 1984 it was announced that Ontario and the other eastern

Canadian provinces had agreed with the federal government to reduce sulphur dioxide emissions by 1994 to 50 per cent of 1980 levels. Ontario's share of this reduction and subsequently Ontario Hydro's share have yet to be determined. However, it is possible that Ontario Hydro's emissions will be further regulated in the post-1990 period.

Any additional regulation is likely to have a significant effect on Ontario Hydro's operations. Much of Ontario Hydro's emission reduction program depends upon maximizing the use of clean nuclear power. However, when the last of the committed nuclear units has become operational in 1992, Ontario Hydro will likely have to rely on additional fossil capacity to meet new demands and provide electrical energy security. The manner in which the growing load can be met within the acid gas regulations of the future is a difficult issue which must be resolved.

## NUCLEAR FUEL WASTE MANAGEMENT AND NUCLEAR SAFETY

There is public concern about nuclear fuel waste management and nuclear safety in general. However, there is general agreement internationally, among those who work in the field, that a number of options are available for the safe disposal of highly radioactive nuclear waste. Nuclear fuel wastes are currently stored at existing nuclear stations and can continue to be stored safely and economically for fifty years or more.

The risks inherent in nuclear power generation have been the subject of many comprehensive studies. In Ontario, the Royal Commission on Electric Power Planning and the Select Committee of the Ontario Legislature on Ontario Hydro Affairs have investigated and reported on the issues surrounding nuclear power. Their reports are widely accepted and indicate that the risks associated with the nuclear power industry are very small and should be acceptable to the public.

## NANTICOKE GENERATING STATION



Coal-fired stations will increasingly be used to satisfy intermediate and peaking demand.

## ELECTRICITY EXPORTS

Ontario is able to take advantage of opportunities to export electricity because it now has a surplus in its generating capacity. In 1984 Ontario

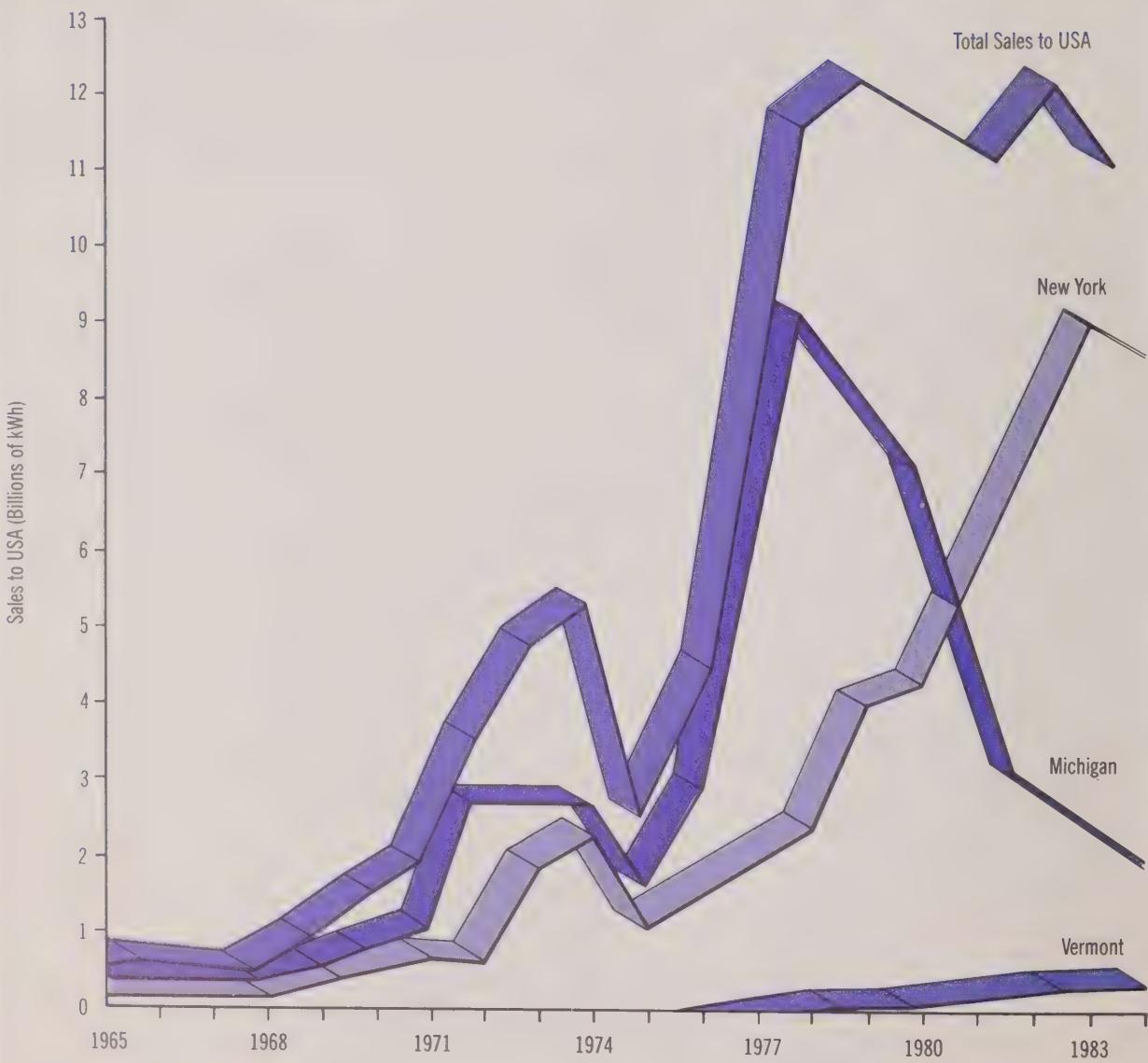
Hydro earned revenues of \$427 million in export sales to the United States, and this income resulted in rate relief of about 5 per cent to Ontario electricity consumers.

Electricity export markets in the future are expected to be more compet-

itive than they have been in the past few years. Success in the market is also going to be moderated by transmission restrictions in the United States.

### ONTARIO HYDRO'S ELECTRICITY EXPORTS

### MARKET TRENDS BY STATE (1965-1984)



Changing electricity export markets in the U.S. represent about 10% of Ontario's electricity demand.

## FINANCING NEW CONSTRUCTION

Maintaining the financial soundness of a utility is a primary consideration. Ontario Hydro's current generation and transmission construction program will be completed in the early 1990s.

When developing this program, projections of electricity demand growth were substantially higher than they

are now. While adjustments to its plans have been made in light of the lower growth, Ontario Hydro today has, and for a number of years will continue to have, additional generation capacity above the normally required reserve margin.

The costs associated with under utilized plant have to be recovered over lower-than-forecast electricity sales. Ontario Hydro therefore faces a significant challenge in controlling its costs and in finding new markets for electricity to ensure that electricity

rate increases remain reasonable while maintaining the financial soundness of the corporation. Planning the future development of the supply system must take into account financial constraints. Commitment to new construction is phased to accommodate borrowing requirements and to moderate the impact on rates. Flexibility should be built into the plans to permit adjustment to growth in electrical demand that is higher or lower than anticipated.

DARLINGTON NUCLEAR GENERATING STATION UNDER CONSTRUCTION



Canada's largest megaproject will ensure that Ontario's electricity needs are met well into the future.

## DECIDING THE FUTURE

Electricity is largely an indigenous resource for Ontario. It is a versatile energy form, and relative energy costs have made it increasingly attractive to the energy consumer. Electricity's share of the energy market is therefore expected to grow. Ontario Hydro has the responsibility to plan the electrical system in accordance with government policy. The Ontario government, following its agreement in principle to the general plan, is responsible to the residents of Ontario for approving the development of the specific facilities. The Legislature has fulfilled this responsibility in the past through such

statutes as the Power Corporation Act, the Environmental Assessment Act, and the Consolidated Hearings Act. In order to ensure that the regulatory framework remains responsive to the need for timely development of the electrical system and at the same time provides for a comprehensive planning procedure with ample public involvement, the government continually reviews and updates its legislative base.

The Minister of Energy for Ontario has the responsibility to report to the Ontario Legislature with respect to Ontario Hydro.

The annual reports of Ontario Hydro and the Ministry of Energy are tabled by the Minister in the Legislature and are subject to review and

questioning by committees of the Legislature. Significant events relating to Ontario Hydro operations are also reported by the Minister to the Legislature.

As changes occur in energy supply in Ontario and changes in the economy require new plans to meet the energy demands of the province, the Minister of Energy will continue to give policy direction to Ontario Hydro. The objective of the process for developing and reviewing electric power plans is part of the government's efforts to integrate Ontario Hydro's system planning with the overall energy supply requirements and the needs of the Province.

### ONTARIO LEGISLATURE IN SESSION



The Legislature is ultimately responsible for approving Ontario Hydro's electricity supply system plans.



